

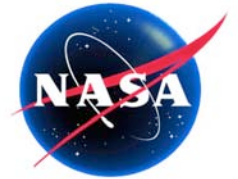
GFEP

GS SDR Section 11

Ross Cox
Ground System Engineer



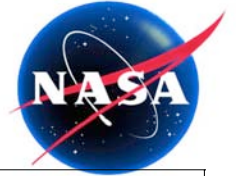
Outline



- ▶ *Since SRR*
- ▶ *GFEP Overview*
- ▶ *Concepts of Operation*
- ▶ *Software*



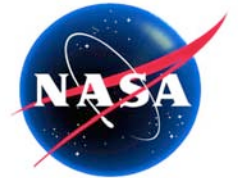
Since SSR Peer Review RFA Resolutions



RFA	TOPIC	Status	Resolution
1	Sustaining engineering	CLOSED	Sustaining Engineering activities have been defined and described/
2	WAN data rate estimates	CLOSED	Rates have been revised to best current estimates
3	Ground receipt time	CLOSED	No clock correlation is being performed so highly accurate GRT is not required.
4	Contingency and return to service	CLOSED	Provided explanation of paging system, contingency responses and RMA requirements
5	MOC system and GFEP interface	CLOSED	Matured MCE ops concept
6	Playback GFEP autonomy	CLOSED	Automated Push not required remote initiated push will be used
7	Implementation effort	CLOSED	Completed GFEP staffing with MOMS & NENS contractors



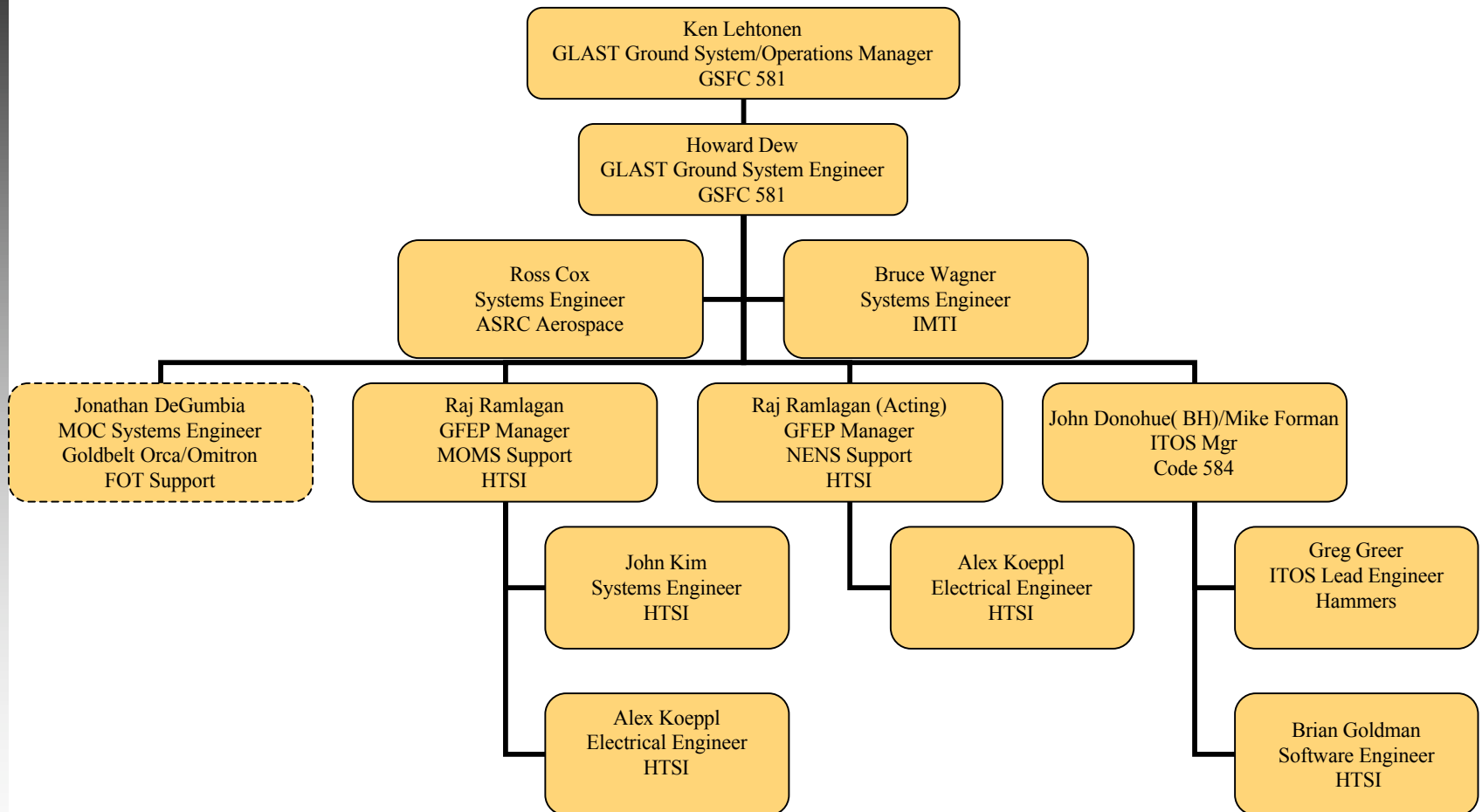
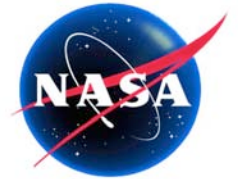
Since PDR DDPR RFA Resolutions

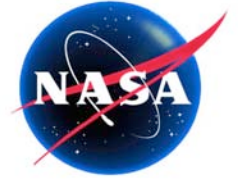


DDPR RFA	TOPIC	Status	Resolution
1	RT OPS WRT ARs	Resolved	Explained AR impacts to Ops
2	Rooftop Ku @ GD	Resolved	No Impact to GFEP Explained Plans
3	GFEPs in GD Clean Room	Resolved	Accept Recommendation to avoid this if possible
4	Provide detailed Data Flows into and out of MOC and I&T Facility	Resolved	Provided Flows
5	Encryption and authentication in commanding the spacecraft	Resolved	GFEP does not send commands. The command encryption issue is being tracked at the Project Level
6	CNE, Restricted IONet and Closed IONet Connectivity	Resolved	MOC is on Restricted IONet All Connections are through appropriate firewalls.



Since PDR GFEP Development Organization





GFEP Overview - Why GFEP?

▶ ***GLAST Mission Requirements Include:***

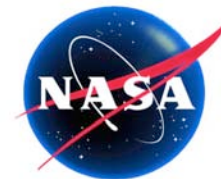
- *40 Mbps Ku-band Return Data*
- *Reed Solomon Decoding*
- *On-site VC Splitting*
 - *Separation Of Low Rate RT Channels From High Rate Stream*
- *Storage For 7 Days*
- *Autonomous System For Support GLAST 8x5 MOC Ops*

▶ ***Project Independence From Other Missions***

▶ ***Desire For Passive Interface To WSC***



GFEP Overview Data Supported



▶ The GFEP Supports Ku-band Return Data ONLY:

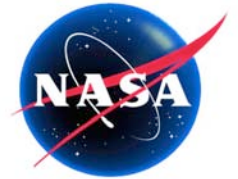
- Real Time Housekeeping Telemetry
 - 51 Kbps On VC0
- Real Time Burst Alerts And Diagnostic Data
 - 1 Kbps For Burst Alerts On VC1
 - ~49 Diagnostic Kbps On VC1
- Observatory Stored RAM Dumps
 - 5 Mbps (Instead Of Observatory HK Recorder Dumps) On VC2
- Observatory Housekeeping Recorder Dumps
 - 8 Mbps On VC 3
- LAT And GBM Science Recorder Dumps
 - 34.9 Mbps On VC 8 And 9
- Fill Frames
 - On VC63

▶ The GFEP Does NOT Support:

- S-Band
 - Commanding
 - Non-contact Burst Alerts Or Safehold Telemetry
 - Via DAS(MA) On VC 11
 - “Low Rate” Real Time Observatory Housekeeping Telemetry
 - 1 Kbps Via MA Return On VC10
 - 4 Kbps Via SSA Return On VC10
 - “Low Rate”, I.E., 2.5 Mbps Observatory Housekeeping Recorder Dumps



Concepts of GFEP Operation Basics

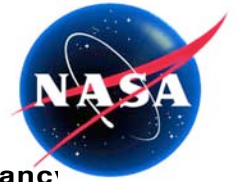


- ▶ ***There are two types of GFEP Elements, RTEs and PBEs***
 - *Real Time elements transmit Real time data*
 - *PBEs transmit Playback Data*

- ▶ ***Similarities***
 - *Both receive 40 Mbps stream from WSC equipment*
 - *Both save raw data*
 - *Both separate and save VC files*

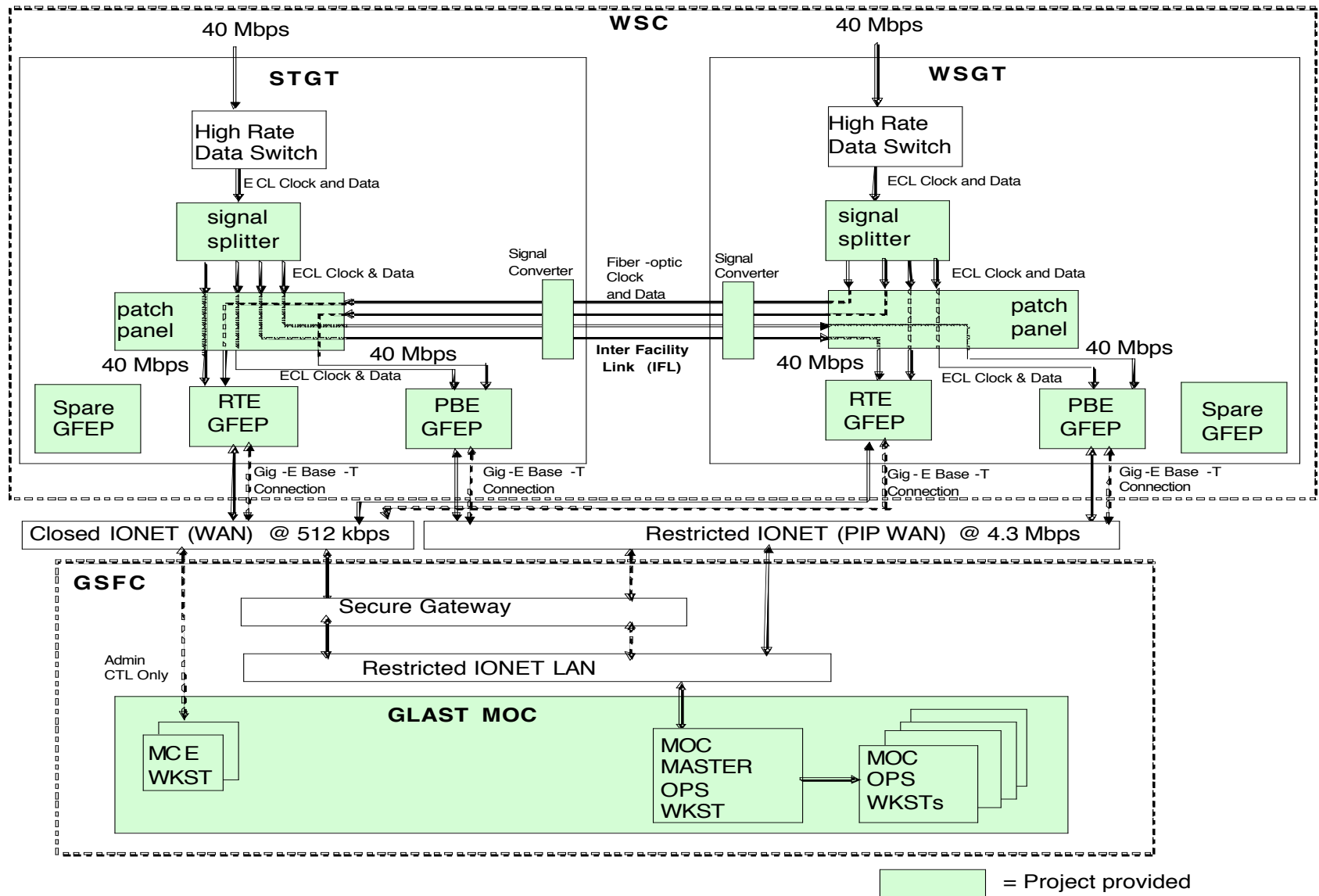
- ▶ ***Differences***
 - *RTE transmits to MOC during real time*
 - *PBE transmits to MOC post pass*

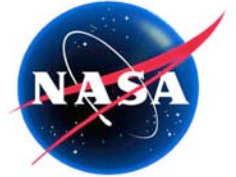
- ▶ ***NO COMMANDING VIA GFEPs***



System Architecture

GLAST K_uband Front End Architecture With Ground Terminals Strapped Redundancy





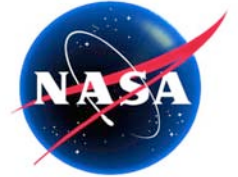
Concepts of GFEP Operation

- ▶ **The MOC will receive two real time streams and select which one to broadcast to the other MOC terminals**
 - *Both RTE can flow data at the same time due to small real time bandwidth required*
- ▶ **Each PBE will establish two socket connections to the MOC master workstation**
 - *Connections are for status and control*
 - *Only one PBE will be designated as prime and it will establish its playback data connection after each pass via commercial software data transfer activated from a STOL procedure on the PBE*
- ▶ **Once initialized and connected all four machines (both RTEs and PBEs) maintain connectivity via status messages to the MOC.**
- ▶ **The GFEPs are data driven and not scheduled**



Concepts of GFEP Operation

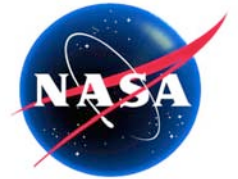
Contingencies



- ▶ **Playback Failure**
 - *FastCopy does not transmit data*
- ▶ **GFEP Element Shutdown**
 - *RTE or PBE Failure*
- ▶ **GFEP Control Function Failure**
 - *MOC workstation (MCE) Failure*
- ▶ **Network Failure**



Software Design



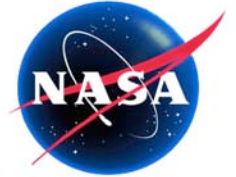
► **Architecture**

– *ITOS coupled to the STPS packet processor*

- *Incorporates the robustness and reliability of the STPS packet processor with the robustness and reliability of ITOS*
- *Capitalizes on existing ITOS to ITOS directives*
- *Retains the ability to extend operations concepts without significant impacts to software baseline*
- *Retains user interface and operator environment*

► **Non Recurring Engineering**

- *Integrate STPS and ITOS*
- *Incorporate software interface to EDT card*
- *Add code to generate and forward processing status block to MOC*
- *Add file transfer application (FastCopy, FTP, etc)*
- *Develop appropriate STOL scripts and local displays*



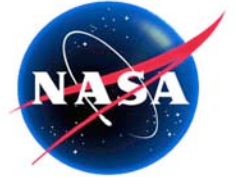
Software Component Reuse

► ITOS

- *Display Subsystem -- GUI, pages, trends and plots*
- *STOL Subsystem -- Automation and remote control*
- *Telemetry Subsystem Components -- Frame archiving, buffering, and forwarding with robust socket maintenance*

► STPS

- *Active Port Select*
- *Telemetry input, frame synchronization, de-randomization, and Reed-Solomon Decoding*
- *Archive raw bit stream*
- *Status reporting*
 - *Updated to share existing status counters with ITOS*
 - *Update frame quality wrapper (or add compatible quality wrapper handler to ITOS)*



Common GFEP/MOC Interfaces

► **Maintenance**

- *Operating system and application patches and upgrades. OS patching is provided by applications within the OS.*
- *Application patches and updates will be applied manually using file transfer and remote login.*

► **Remote control**

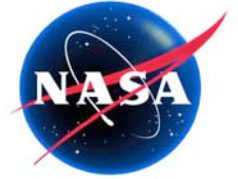
- *STOL to STOL socket interface already available in ITOS*

► **File transfer**

- *FASTCopy product from SoftLink will be used for all telemetry file transfers.*



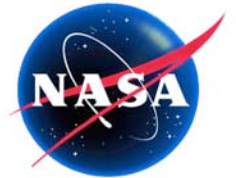
Operational Hardware Baseline



► **Architecture**

- *Intel Dual CPU Based Box*

- *Pentium 4 3.2 GHz Xeon CPU processor with 2 MB CPU Cache*
- *4GB RAM*
- *RAID 5 Ultra 320 SCSI RAID Controller board (500GB)*
 - *Size for 126Gb x 7 Day requirement*
- *Gigabit NIC Card*
- *EDT 400 (dual port) card (baseline is one card per RTE/PBE)*



Performance Tests To Date

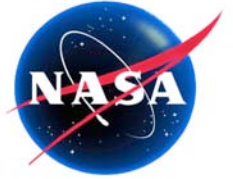
- **STPS Packet Processor, input from Analog Recorder with output to monitor**

Processor Speed: Dual Xeon 2.4Ghz Operating System: Enterprise RedHat 3.0 CPU Usage: 30-40% at 40Mbps

Clock Freq (Mbps)	Frame Sync	RS-D	Pn-D	Disk Store	Xmited frames	RS Error Insert	Frame Drop	RS Corr Error	Good Frames
25	On	Off	On	On	3830000	N/A	1	N/A	3830000
25	On	On	On	Off	3830000	224	1	224	3830000
25	On	On	On	On	3830000	224	1	224	3830000
30	On	On	On	Off	3830000	224	1	224	3830000
30	On	On	On	On	3830000	224	1	224	3830000
35	On	On	On	Off	3830000	224	1	224	3830000
35	On	On	On	On	3830000	224	1	224	3830000
40	On	Off	On	Off	3830000	N/A	1	N/A	3830000
40	On	On	On	Off	3830000	224	1	224	3830000
40	On	On	On	On	3830000	224	1	224	3830000



Development Process & Schedule



► *Spiral Development Model*

– *August04*

- *Baseline GFEP Design and I&T Plan*
- *Support GLAST SDR*
- *Integrate ITOS and Prototype HW in B25*

– *September04*

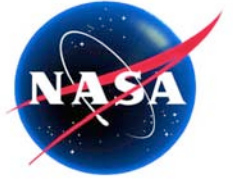
- *Baseline GFEP Design Document*
- *Deliver GFEP SW Release 1.0 (Engineering Release)*
- *Perform functional tests in B25*

– *November04*

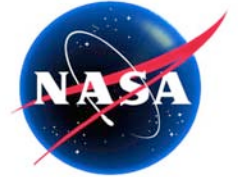
- *Deliver 2 Functional Prototypes to B23*
- *Conduct interface testing in B23*



Development Process & Schedule



- ▶ ***Integrate in B25, B14 then WSC***
 - *December04*
 - *Continue interface testing*
 - *January05*
 - *Deliver GFEP Operational Release 1*
 - *Conduct GFEP stress tests in B23*
 - *Initiate MOC/GFEP interface testing in B14*
 - *March05*
 - *Deliver GFEP Operational Release 2*
 - *Conduct regression MOC/GFEP interface tests in B14*
 - *Utilize WAN network connectivity*
 - *April05*
 - *Conduct GFEP pre-ship review*



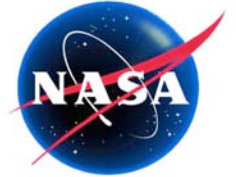
Maintenance Strategy

Configuration Management

- *All software (ITOS, STPS, EDT, procs) will be maintained under the ITOS CVS repository in Code 584's Real-Time Application Laboratory.*
- *Operational releases will be delivered to the Code Software Library*
- *Documentation will be delivered to NASA and maintained in HTSI's HIIMS portal*

► Sustaining Engineering

- *Hardware and software sustaining will be performed under Code 444*

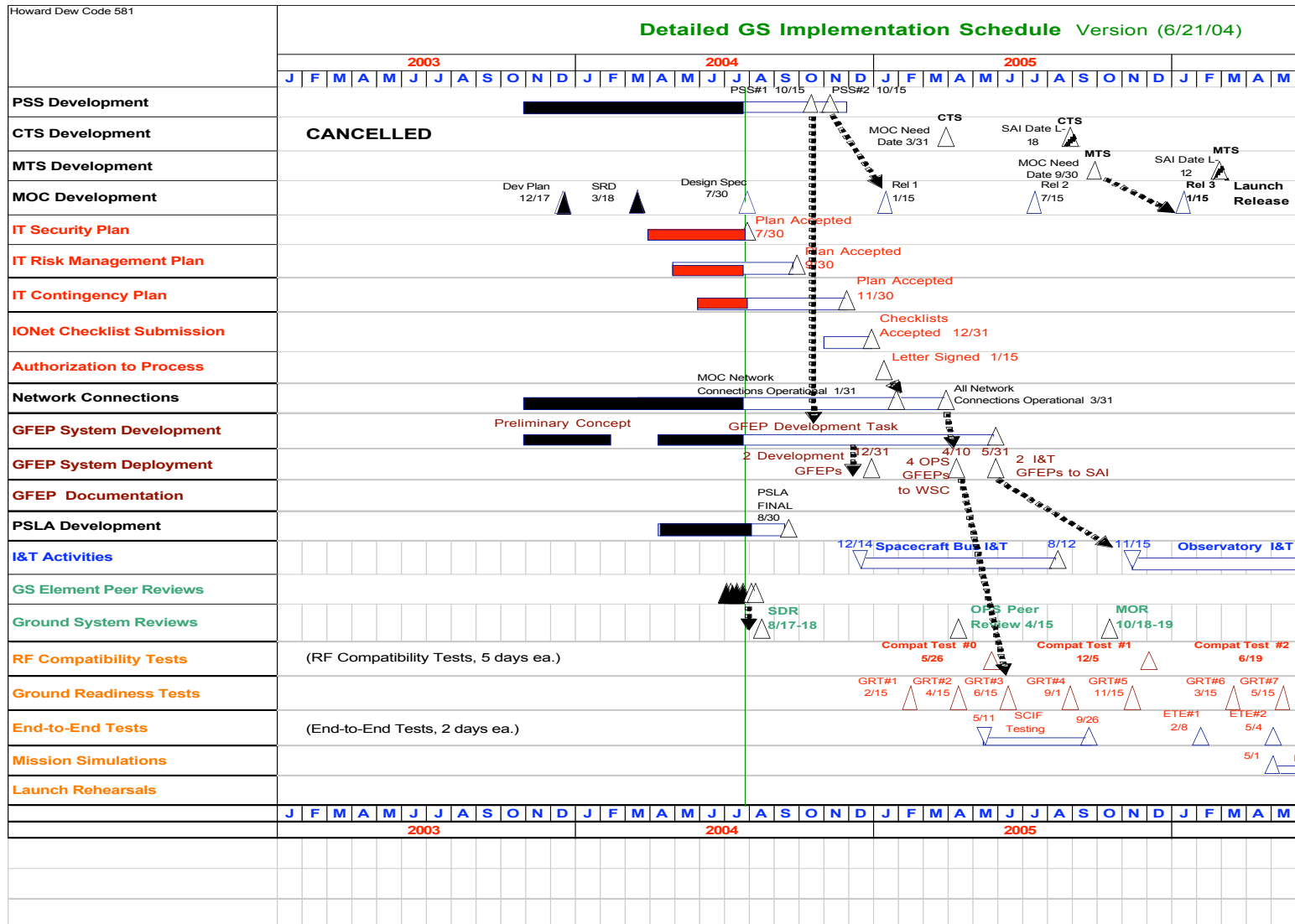
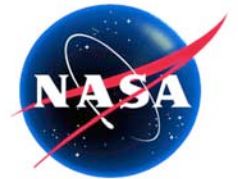


Required Documentation

<i>GFEP Functional And Performance Specification</i>	<i>8/30/04</i>
<i>ICD Between GFEP And MOC</i>	<i>Draft 8/30/04</i> <i>Final 11/30/04</i>
<i>ICD Between GFEP And WSC</i>	<i>Draft 8/30/04</i> <i>Final 11/30/04</i>
<i>GFEP Appendix to ITOS User's Guide</i>	<i>Draft 11/30/04</i> <i>Final 3/31/05</i>
<i>Design And Configuration Drawings</i>	<i>1/31/05</i>
<i>Ops Agreement Input to MOA Between GLAST And WSC</i>	<i>1/31/05</i>

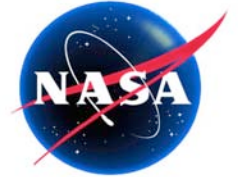


Programmatics GS Development Schedule





Pending Design Issues



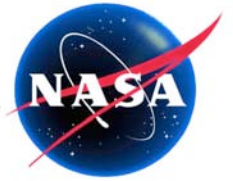
► **ITOS integration**

- *To handle diagnostic data bursts of up to 900 kbps with a 512 kbps output network connection, the GFEP needs to utilize ITOS' ability to buffer telemetry output.*

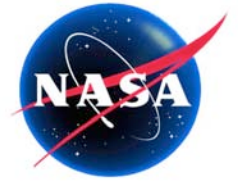


Programmatics

The Road to GFEP Readiness Review

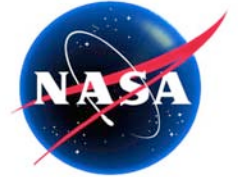


- ▶ ***Begin efforts with development machines***
 - *Port over necessary software*
 - *Connect to various data sources*
 - *Test and Demonstrations of Capabilities*
 - *Detailed Installation discussions with WSC*
- ▶ ***Clone Development Machines into Ops Machines***
 - *Bench test them*
 - *Ship to WSC and install*
 - *Installation Test*



Conclusion

- ▶ *The design is stabilized around a workable solution*
- ▶ *We are aware of the remaining issues and have plans to effectively deal with them*
- ▶ *We have proto-type results that show we can meet requirements*
- ▶ *We have procured two development machines for software development and test*



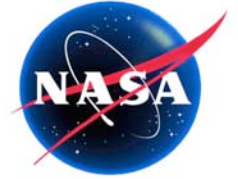
GFEP Backup Slides

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Concepts of GFEP Operation Initialization

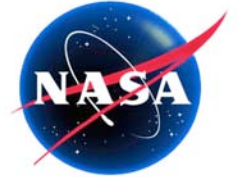


- ▶ **Six machines are at WSC**
 - Two at WSGT and Two at STGT with one cold spare at each site
 - Any machine can be brought up as either an RTE or a PBE (not both)
- ▶ **The MOC will designate a single MOC workstation as Master**
 - Receive all telemetry and status blocks
 - Execute ground and observatory PROCs
- ▶ **The MOC will have an MCE workstation to configure RTEs and PBEs**
 - It notifies the RTE and PBE which MOC workstation is Master
 - Each RTE will establish three sockets to the MOC master workstation
 - Connections are for data, status and control



Concepts of GFEP Operation

Contingencies - The GOOD News

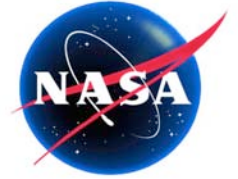


- ▶ ***Ops con has lots of room to make up for loss of a playback support***
 - *Designed to deal with 5 hour off pointing operations due to TOO or AR*
 - *We will schedule 10 minute supports*
 - *5 min 17 sec needed to get typical three hours of science played back*
 - *If we start 40 sec after AOS and end 5 sec before LOS then 9 min 45 sec is available per support.*
 - *10 min for a whole day of housekeeping - not an issue*
 - **All Daily Science Data could be acquired in 5 passes**
 - *May transition to a 5 pass operation in out years, but baseline is eight supports with 7 minutes of Ku-band downlink ability.*



Concepts of GFEP Operation

Contingencies - The GOOD News



- ▶ ***Since MOC commands Dump start, It's hard to lose a dump***
 - *SC will not dump into the void*
- ▶ ***Passes could be added for strange situations***
 - *Full recorder*
 - *TDRS conflict with other missions*
 - *Operator induced data loss*



GFEP Test Environment

